COMPUTER APPLICATIONS IN ENVIRONMENTAL ENGINEERING

EV710 **L:T:P = 3:0:0** **CIE: 50 Marks**

Hours/week: 3(L) **SEE: 100 Marks**

Course Objective

This unique course lays a strong foundation for the students to appreciate, understand and develop theoretical knowledge related to computer programme writing skills for a variety of environmental engineering applications and stresses the need for CAD and analysis.

Course outcomes (COs)

At the end of the course the students will be able to:

CO1: Outlines and writes programmers related to population forecasting and water supply and treatment system design
CO2: Ability to develop skill of writing programmers for wastewater collection and treatment units design and understands Streeter-Phelps and other water quality prediction models
CO3: Gains knowledge to perform exercises related to predicting ground level air pollutant concentrations, effective stack height calculation and design of particulate matter control units through C programming language
CO4: Acquires theoretical base on CAD, computer graphics and DBMS and their applications in the field of environmental engineering
CO5: Have an exposure to various softwares related to water and air quality prediction, design of water supply system, sewerage system and air pollution control systems.

COURSE CONTENT	Hours
Population Forecast Programs: Arithmetic Increase Method, Geometric Increase Method And Incremental Increase Method.	**04**
Water Supply And Treatment Programs: Rising main design, pumping unit, Water treatment units design — Cascade aerator, plain sedimentation tank, clariflocculator tank, filters (rapid and slow) and disinfection	**07**
Wastewater Collection And Treatment Units Programs: wastewater treatment units – Screen and Grit chamber, Primary settling tank, Aeration tank and Secondary settling tank of ASP, Trickling filter unit, Sludge drying beds and Septic tank.	**08**
Aquatic Systems Programs: Water quality models for discharge of conservative and non-conservative waste in rivers, DO models for rivers (Streeter- Phelps equation).	**05**
Air Quality Programs: Effective Stack height calculation, Gaussian Plume Model for gaseous and particulate dispersion from point sources. Design of particulate control devices – Settling chamber and cyclone separators.	**05**
(Writing Flow Sheets, 'C' programme along with Design Steps & Equations is compulsory). **CAD:** Introduction to CAD and its application to Environmental Engineering; Introduction to Computer Graphics – Applications.	**02**
Introduction to Application Software's - RMAIN, WATPLANT, DOWATTS, LOOP, QUALOOP, EPANET, SEWER, STREAM, ISCST/LT, CALINE, MIXING ZONE MODELS, SWMM (storm water management model), MATLAB.	**08**
TOTAL	**39**

REFERENCES:

- Thomann, R. V., and Mueller, J.A., (1987), **"**Principles of Surface Water Quality Modeling and Control" –,Harper Int. Edition.
- Krishna Murthy, C.S., and Rajeev, S., (1998), **"**Computer Aided Design software and Analytical Tools"– Norosa Publishing House.
- Wark K. Warner, G.F., and Davis, W.T., (1998), **"**Air Pollution its Origin and Control**"** – Addison- Wesley.
- Sincero, A.P., and Sincero, G.A., (1999), **"**Environmental Engineering – A Design Approach" - Prentice Hall of India.
- Water Supply and Treatment – CPHEEO Manual (Latest version), New Delhi.
- Wastewater Collection, Treatment & Disposal – CPHEEO Manual (Latest version), New Delhi.

ATMOSPHERIC ENVIRONMENTAL ENGINEERING

EV 720 **L:T:P = 3:1:0** **CIE: 50 Marks**
Hours/week: 3(L) +1(T) **SEE: 100 Marks**

Course Objective:
The course covers the air pollution sources, classification, effects, and measurement of air pollutants, standards, importance of meteorology in air pollutant dispersion, fate and transport of air pollutants using various mathematical tools, as well as air and noise pollution control technologies and regulations.

Course outcomes (COs)
At the end of the course the students will be able to:

CO1: Understand the importance of composition and structure of atmosphere, sources, classification, effects of air pollutants, measurement of air pollutants and air pollution standards and control regulations
CO2: Able to understand the basic concepts of various meteorological factors which influence the dispersion of air pollutants
CO3: Prediction of dispersion of air pollutants using Gaussian plume and Box models and to calculate the plume rise using various model equations
CO4: Understand the basic mechanisms involved, working principles and design aspects of various air pollution controlling equipment
CO5: Know about sources, standards, measurement, effects and general controlling methods of noise pollution, assessment and control of indoor air quality.

COURSE CONTENT	Hours
Introduction: Composition and Structure of atmosphere, scales of air pollution problem – local, regional and global. Air pollution episodes – Bhopal Gas Tragedy, London and Los Angeles Smog, Sand / Dust Storms	**05**
Sources of air Pollutants: Natural and Anthropogenic, Units of measurements of air pollutants. Simple problems on unit conversion.	**02**
Classification of air Pollutants: Primary and Secondary Pollutants. Photochemical Oxidants, Characteristics, Smoke and its measurement**.**	**03**
Effects of Air Pollution Effect of air pollutants on human, plants and animals, materials and structure/ monuments. Effects of air pollutants on visibility and other related atmospheric characteristics, Acid rain, Wet Deposition, Greenhouse effect. Global warming. Ozone depletion and Heat island effect**.**	**05**
Measurement of Air Pollutants Criteria for station selection, Measurement of various gaseous (CO, HC, NOx, SOx, etc) pollutants, particulate matter and microbial, sampling devices, sampling train, sampling methods/ techniques, stack sampling techniques. VOCs and Odor.	**05**
Air Pollution Control Regulations Air pollution laws/ acts, air quality and emission standards, air pollution indices - determination of air pollution index by different methods.	**04**
Air Pollution Meteorology Role of meteorology in air pollution and its control. Meteorological factors – Solar radiation,	**08**

temperature, lapse rate, wind velocity profile, humidity, precipitation, Maximum/ Mean mixing depths, atmospheric stability conditions, wind rose diagram. Inversion – types, plume behavior under different atmospheric stability conditions, Pasquil – Gifford atmospheric stability classification. Effect of topography on pollutant dispersion.	
Atmospheric Dispersion of Stack Emissions Plume rise, effective stack height, plume rise formulations, guidelines for fixing stack height, problems on plume rise calculations.	**06**
Box model and Gaussian Plume Model.	**04**
Air Pollution Control Equipment General methods, control by process changes Particulate Matter Control – settling chambers, inertial separators, cyclones, fabric filters, scrubbers, wet collectors, and electrostatic precipitators. Design aspects. Control of gaseous pollutants – adsorption, absorption, combustion and condensation.	**06**
Indoor Air Pollution Indoor air quality – hospitals, health care facilities, residential and commercial establishments, effects and control, air changes per hour (ACH), IAQ Standards	**02**
Noise Pollution: Sources, Effects, Controls and Units of measurements, Standards	**02**
TOTAL	**52**

TEXT BOOKS

- Wark, K. Warner, C.F. and Davis, W.T. (1980), "Air Pollution its Origin and Control", Harper& Row Publishers, New York.
- Henry, C. Perkins, (1980), "Air Pollution", McGraw Hill Co., New Delhi.

REFERENCES

- Boubel, R.W., Donald, L.F, Turner, D.B. and Stern, A.C.(1994),"Fundamentals of Air Pollution" Academic Press, New York.
- Crawford, M. (1980), "Air pollution Control Theory", THM Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- Noel De Nevers, (2000), "Air Pollution Control Engineering", International Edition. McGraw Hill International
- Sincero, A.P. and Sincero, G.A. (1999), "Environmental Engineering – A Design Approach**"** Prentice Hall of India, New Delhi.
- Emission Regulations 1, 2, 3, CPCB.

OPERATION AND MAINTENANCE OF ENVIRONMENTAL FACILITIES

EV 730	**L:T:P- 4:0:0**	**CIE:50 Marks**
Hours/week: 4(L)		**SEE:100 Marks**

Course Objective:

The course encompasses intricate aspects regarding operation and maintenance of environmental facilities

Course Outcomes (COs)

At the end of the course the students are able to:

CO1: The learner understands the need for O & M, basic principles, learns organization structure, work plan scheduling and the necessity of automation in environmental facilities
CO2: Able to identity operational problems and develops a plan for corrective measures of water supply and treatment facilities
CO3: Capable of listing operational problems and providing corrective measures for wastewater collection and treatment facilities
CO4: Develops sufficient knowledge on operational problems and remedial measures of air pollution control equipment
CO5: Gains knowledge on O&M of sanitary and hazardous waste disposal facilities.

COURSE CONTENT	Hours
Operation, Maintenance & Management: Aims, Basic Principles, Data Base Facilities, Drawings, Plans, Maps, Records, Organizational Structure, Work Planning and Scheduling, Operation Manuals, Training needs and planning.	08
Water Supply Facilities Operational Problems and Corrective Measures for Intakes, pumps, rising mains, Distribution System - Loss of carrying capacity in pipes, Projection of Pipe Break Rates, Leak Detection and control. Appurtenances – Valves, Hydrants and Fittings.	**08**
Water Treatment Facilities Operational Problems and Corrective Measures for Screens, Aeration Unit, Sedimentation Tank, Clariflocculator, Pulsators, Filtration, Disinfection units, RO and other treatment units.	**08**
Wastewater Collection Facilities Operational Problems and Corrective measures in Sewer Network, Inspection Methods, Safety Methods, Appurtenances and pumps.	**08**
Wastewater Treatment Facilities Operational Problems and Corrective Measures for Screens, Grit chamber, aeration tanks, trickling filters and bio-towers, settling tanks, Sludge Thickener, sludge digesters, sludge drying beds, Disinfection units, Adsorption tower.	**08**
Air Pollution Control Facilities Operational Problems and Corrective Measures for Gravity Settlers, Cyclone Separators, Bag Filters, Scrubbers, Electrostatic Precipitators, and Gaseous Emission Control Devices – Absorption Beds and Adsorption Columns, Thermal Oxidizers, Incinerators.	**08**

O & M for Solid waste management (SWM) facility, hazardous waste disposal sites and Fecal Sludge Management (FSM).	**02**
Computer applications in Operation and Maintenance of Environmental Facilities. Product catalogue and technical data sheets.	**02**
TOTAL	**52**

TEXT BOOKS

- Metcalf & Eddy Inc, (2003), "Wastewater Engineering, Treatment and reuse"-4th Edition, Tata McGraw Hill Publishers Co. Ltd, New Delhi
- Training Manual on O&M for Municipal Staff", Asian Development Bank, Government of Karnataka
- CPHEEO, (Latest Version), "Manual on water supply and Treatment", Ministry of Urban Development, GoI, New Delhi.
- CPHEEO, (Latest Version), "Manual on Sewerage and Sewage Treatment", Ministry of Urban Development, GoI, New Delhi.

REFERENCES

- Hammer, M.J., (1986), "Water and Wastewater Technology–SI Version" -2nd Edition, John Wiley and Sons.
- William L Neumann, (1997) "Industrial Air Pollution Control Systems" – McGraw- Hill Professional.
- Walski, T.M. (1987),"Analysis of Water Distribution Systems" – CBS Publications, New Delhi.
- Raju, B. S. N., (1991), "Water Supply and wastewater Engineering by B.S.N. Raju" – Tata McGraw-Hill Publishing Co. Ltd.
- Manual on Solid waste Management" – CPHEEO (Recent edition)

APPLICATION OF STATISTICS IN ENVIRONMENTAL ENGINEERING
(ELECTIVE II)

EV 741	**L:T:P- 4:0:0**	**CIE: 50Marks**
Hours/week: 4(L)		**SEE:100Marks**

Course Objective:
The student will have an overall understanding of statistics, types, and applications for effective management of environmental data. It covers a wide range of statistical aspects including data characteristics and grouping correlation & regression, probability, testing hypotheses and time series analysis

Course Outcomes (COs)
At the end of the course the students will be able to:

CO1: The student outlines different forms of data, characteristics of data and its grouping, frequency analysis.
CO2: Able to learn skewness of the data, moving average and weighted mean concepts
CO3: Ability to analyse data distribution using random and non- Random sampling, variance, probability and probability distribution
CO4: Able to calculate different types of correlation coefficients for a given set of data using linear, non-linear and multiple regression techniques
CO5: Understands clearly the time series analysis of data to establish trend and seasonal variations and uses methods of testing hypotheses

Course Content	**Hours**
Characteristics of Distributions: Central Tendency – Averages: Arithmetic mean (Ungrouped data & Grouped data); Median (Ungrouped data & Grouped data); Mode (Ungrouped data & Grouped data); Skewness; Geometric mean; Weighted mean; Moving averages – equations to river hydraulics; Problems	07
Characteristics of Distributions: Dispersion – Range; Interquartile Range; Variance; Standard Deviation (Population & Sample); Bessel's correction; Mean Deviation; Coefficient of Variation; Problems.	06
Probability distributions: Binomial distribution – derivation; Poisson distribution – derivation; Normal distribution – errors, Gauss function, Area under normal curve, Use of standard normal probability distribution table; Problems.	06
Sampling and Sampling Distributions: Types – nonrandom and random; Biased samples; Random sampling; Systematic sampling; Stratified sampling; Cluster sampling;	06
Correlation and Regression Analysis: Scatter Diagrams; Correlation coefficient; Multiple correlation coefficient; Simple linear regression; Multiple regression equation; Estimation using regression line; Method of Least Squares; Standard error of estimate	07
Time Series – univariate and multivariate; Problems. Introduction to design of experiments – Statistical package for Social sciences (SPSS).	04
Testing Hypotheses: Concepts basics; Null hypothesis; Level of Significance; Degrees of Freedom; Hypothesis testing of Means; Chi-Squared test; F distribution; Students t- test; Analysis of Variance – within samples and between samples; Problems.	07
TOTAL	**52**

TEXT BOOKS

- Adam M. Neville and John B. Kennedy, (1966), “Basic Statistical Methods for Engineers and Scientists”, 2nd Edition, IEP
- Richard I. Levin and David S. Rubin, “Statistics for Management” (1998), Prentice Hall of India Pvt. Ltd., New Delhi.

REFERENCES

- George E. P. Box, William G. Hunter, and J. Stuart Hunter, “Statistics for Experiments - An Introduction to Design, Data Analysis, and Model Building”, John Wiley & Sons.

ENVIRONMENTAL ECONOMICS, LEGISLATION AND FORENSICS (ELECTIVE II)

EV 742	**L:T:P- 4:0:0**	**CIE:50 Marks**
Hours/week: (4L)		**SEE:100 Marks**

Course Objective:
The course provides a solid foundation on basics of environmental economics, its necessity, establishes a strong link between environment and economics. Understands the social and economic costs, valuation techniques and their application. It also covers environmental policy, acts, rules and regulations for effective pollution prevention and control.

Course outcomes (COs)
At the end of the course the students will be able to:

CO1: Able to relate the impact of externalities on natural resources and defines social cost functions.
CO2: Understands the economics of exhaustible and non-exhaustible resources, appreciates the need for common pool of resources. Also gets familiarized with the valuation techniques for measuring tangible and intangible benefits.
CO3: Able to relate sustainability and development for resource planning and conservation.
CO4: Capable of describing and understanding the national environmental policy, goals and procedural aspects. Knows in detail the environmental acts, rules, regulations and amendments for the betterment of the society.
CO5: Gains in-depth knowledge on various acts related to environment and applies the same for effective use, conservation of natural resources and concepts of Environmental Forensics.

Course Content	**Hours**
Environmental Economics Introduction to Environmental Economics	**02**
Externalities – Problem of Social Cost and Formal Analysis	**06**
Depletion of Non-renewable resources – Economics of Exhaustible resources.	**06**
Degradation of commons – The tragedy of commons an Institutional approach for common pool resources (CPR)	**04**
Valuation Techniques – Measuring the benefits and costs of pollution control, contingency valuation and economics	**06**
Sustainability – Economics perspective, Environmental Accounting – an operational perspective	**04**
Development and Environment -Poverty and environmental resource base, economics of the green house effect. Microeconomic theory - production or consumption involves externalities, and environmental benefits, Emissions and welfare, Sustainable resource use and economics, Macroeconomic implications for the promotion of environmentally-friendly products.	**06**
Environmental Legislation Environmental Policy, Legal frame work for environmental protection. Need, Constitution of India, Environmental Jurisprudence, Environmental Acts, Rules	**06**

and Regulations, Amendments.	
Indian Environmental Acts – Environment (Protection) Act, 1986, Biomedical Waste (Managing and Handling) Rules, 2011, Recycle Plastics (Manufacturing and Usage) Rules, 1999, Water Act, 1974, Air Act, 1981, The Forest Conservation Act, 1980, Wild Life Protection Act, 1972, Biodiversity Rules, 2004, import of genetically engineered microorganisms, manufacture, storage, import of hazardous chemical rules, 1989, The National Green Tribunal Act, 2010, Coastal Regulation Zone Notification, E – Waste (Management and Handling) Rules, 2011, Batteries (Management & Handling) Rules, 2001, Hazardous Wastes (Management, Handling and Transboundary) Rules, 2008, Municipal Solid Wastes (Management and Handling) Rules, 2000.	**06**
ENVIRONMENTAL FORENSICS: Pollutant Policing: basic aspects, EF past present and future. Measurements of parameters, baselines and value functions, chemical and biochemical finger printing tools and techniques. Statistical interpretation of data. Indices and markers. Pollutants transport models - pathway tracing. Case studies and EF legislation. Life cycle assessment. Futuristic emerging forensics for pollution prevention and remediation – time frames and solutions, integrating environmental forensics with other professional domains.	**06**
Total	**52**

TEXT BOOKS

- Ulaganathan Sankar, (2001), "Environmental Economics", Oxford University Press, UK
- CPR Environmental Education Centre, (2006), "Environmental Laws of India – An Introduction", CPR Publications

REFERENCES

- Ramprasad Sengupta, (2013), "Ecological Limits and Economic Development", Oxford University Press
- Bhattacharya R.N., (2001), "Environmental Economics – An Indian Perspective", Oxford University Press
- KSPCB handbook
- CPCB website and MoEF&CC website

REACTOR DESIGN TECHNOLOGY (ELECTIVE II)

EV 743 **L:T:P- 4:0:0** **CIE:50 Marks**

Hours/week: 4(L) **SEE:100 Marks**

Course Objective:

The course emphasizes mainly on the different types of reactions and reactors, fundamentals of reactor design for isothermal and non-isothermal, homogeneous and heterogeneous, as well as fixed-bed and fluidized-bed reactors.

Course outcomes (COs)

At the end of the course the students will be able to:

CO1: Understand different types of reactions, reactors and their analysis and scale-up of laboratory bench scale reactors.
CO2: Understand the design aspects of reactors using mass balance approach, conservation of mass in reactors and the influencing parameters which affect the efficiency of the reactor.
CO3: Apply the design criteria for batch, semi and continuous reactors under isothermal and non-isothermal conditions, along with their rate equations.
CO4: Understand the structure of the laboratory scale reactors under homogenous and heterogeneous conditions.
CO5: Design fixed bed as well as fluidized bed reactors and their selection for treating the wastewaters.

Course Content	**Hours**
Chemical Reaction and Reactor Engineering: types of reactions, reaction order, rate of reaction, types of reactors, reactors' analysis, Scale up designs.	12
Design Fundamentals – Ideal Reactor Energy Balances, Mass Balance approach, Conservation of Mass in reactors, Influencing parameters- case studies.	10
Isothermal and Non-isothermal Reactors – Design criteria, batch, semi and continuous systems and rate equations	10
Laboratory Reactors – Homogeneous and Heterogeneous Reactors, Structure of Reactors	10
Design of Packed Bed Reactor, Fixed and Fluidized Bed Reactors, Industrial applications, MBR for ZLD plant.	10
Total	52

TEXT BOOKS

- Bailey J.E., and Ollis D.F., (1986), "Biochemical Engineering Fundamentals", McGraw Hill International.
- Himmelblau D.M., (1999), "Basic Principles and Calculations in Chemical Engineering", PHI, New Delhi

REFERENCES

- Smith J.M., (1984), "Chemical Engineeting Kinetics", 3rd Edition, McGraw Hill International
- Kutepor A.M., Bondareva T.I., and Berengarten M.G., (1988), "Basic Chemical Engineering with Practical Applications", Mir Publishers, Moscow
- Geonkoplis C.J., (1999), "Transport Processes and Unit Operations", PHI, New Delhi
- Octave Levenspiel (2008), Chemical Reaction Engineering, Edition 3, John Wiley & Sons, ISBN: 978-81-265-1000-9

ATMOSPHERIC AND COMPUTER APPLICATIONS LABORATORY

EV 75 L **L:T:P- 0:0:3** **CIE: 50 Marks**

Hours/week: 3(P)

Course Objective:

The lab course focuses on atmospheric processes, sampling, monitoring and data interpretation of air pollutants and noise measurements. The lab course also discusses about executing environmental Engineering related software's.

Course Outcomes

At the end of the course the students will be able to:

CO1: Able to carry out different monitoring tests on ambient air quality parameters – gaseous pollutants and vehicle exhaust emissions
CO2: Capable of developing wind rose diagrams, noise measurements and interpretation and measurement of light intensity for different applications. Gets a fair knowledge of stack monitoring and various air pollution control equipment through demonstration.
CO3: Capable of writing and executing programmers related to statistical analysis, population forecasting and water and wastewater systems and prediction of air pollutant dispersion using air quality dispersion models.

Course Content	**Hours**
Air Pollution Monitoring • Introduction to Atmospheric Monitoring: Particulate Sampling – Dust Fall, Particulate Matter - PM10, **PM2.5** using High Volume Air Sampler (H.V.A.S.). • Estimating Sulphur oxides and nitrogen oxides in ambient air using H.V.A.S. • Monitoring and identification of air borne microbes • Exercises on auto exhaust analyzer for Petrol Vehicles. • Exercises on noise measuring instruments. • Exercises on Lux-meter (Light Intensity measuring Instrument) • Windrose Diagrams - Wind Monitoring and Analysis of Data • Stack Sampling Techniques and Demonstration of Stack Monitoring. • Exercises on Ambient Gas Monitoring using GASTEC Device. • VOC meter	21
Environmental System Software To execute the softwares of: Population forecast, rising main design, LOOP water distribution design, Sewer design, WATPLANT, ISCST3 Air pollutant dispersion model and CALINE model.	21
Total : 14 sessions 3hrs each	

REFERENCES

- Noel D Nevers, (2000), "Air Pollution Control Engineering", McGraw Hill International Editions, Civil Engineering Series, McGraw Hill
- Wark K., Warner C.F., and Davis W.T., (1997), "Air Pollution – Its Origin and Control", Third Edition, Prentice Hall of India Publishers
- Crawford M, (1976), "Air Pollution Control Theory", TMH Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi.

INDUSTRY-INSTITUTE INTERACTION PROGRAMME & INNOVATIVE RESEARCH

EV 76 L **L:T:P- 0:0:3** **CIE: 50 Marks**

Hours/week: 3(P)

Course Objective:

The lab course offers opportunities for students to gain exposure into creative innovations to cater social, industry-institute and environmental quality control.

Course Outcomes

At the end of the course the students will be able to:

CO1: understand environmental problems in industries and organizations.
CO2: establish intricate links between laboratory activities to address industrial problems.
CO3: provides adequate input for developing practical solutions for innovative research with creative thinking.

Course delivery	**Hours**
• Environmental problems for attributes: air, noise, water and land in industry and related environmental policies. • Life Cycle Assessment (LCA) • Lab scale studies for identified problems in industries • Use of Laboratory experimental results for industrial application. • Water and Energy balance and operation and maintenance cost • Manufacturing, sources of pollution and treatment process • Solid and Hazardous waste management • Environmental Health and Safety, emergency and disaster preparedness in Industries. • Modification to existing pollution control systems and retrofit • Scale up of laboratory experiments for implementation in pilot and real scale conditions. • EIA and Audits. • Documentation protocols in industries • Incremental / radical innovations for exercising environmental control.	42
Total : 14 sessions 3hrs each	

Note:

1. ***The student group can choose from the above content for Industry-Institute Interaction Programme & Innovative Research depending on the research needs.***
2. ***The student group should give two progress presentation and submit the final report endorsed by the guide.***

TRANSPORT AND FATE OF ENVIRONMENTAL POLLUTANTS

EV 810 **L:T:P- 3:1:0** **CIE:50 Marks**

Hours/week: 3(L) + 1(T) **SEE:100 Marks**

Course Objective: Student builds an understanding and application knowledge on various physical phenomena, chemical and biological processes and their influence on the fate and transport of a variety of pollutants in water, soil and air compartments.

Course outcomes (Cos)
At the end of the course, the students will be able to:

CO1: Understands the fundamentals of mass balance approach and process dynamics.
CO2: Learns the physical phenomena–advection, convection and evaporation processes and able to derive related equations with analytical solutions.
CO3: Describe the concept of mixing zone in natural aquatic bodies and its influence on pollutant dispersion. Derives2-DStreeter-Phelps'sequation and uses it to solve simple numerical problems.
CO4: Differentiates stratified and unstratified lake systems, develops knowledge on dispersion characteristics of pollutants in lakes, estuaries, and ocean environment.
CO5: Acquires sufficient knowledge to derive1 and 2 D equations for pollutant dispersion in sub-surface soil. Applies effectively the Gaussian distribution model to plot ground level concentrations of air pollutants for dynamic meteorological conditions.

COURSE CONTENT	**Hours**
Introduction to Modelling and Transport Processes (rivers, lakes, large lakes, sediments, estuaries, wetlands, subsurface), Process Dynamics, Mass Balance Approach, Material Balance Relationship.	06
Mechanics of Mass Transport: Diffusive and Convective Mass Transport. Fick's Law of Diffusion, Combined Convective-Diffusion Equations for 1 and 2 Dimensions. Analytical Solutions for 1-D & 2-D Cases, Simple Problems.	14
Principal Components of DO analysis, Sources and Sinks of DO, Effects of Oxygen Demanding Waste, Bacteria and Nutrients, Streeter –Phelp's Equation and Expression for Critical Point, 2-D models, Mixing zone concept – types of outfall and mixing regimes, Simple Problems**.**	10
Description of Water Quality Processes in Natural Water Bodies: Lake (stratified and completely mixed), Estuary and Coastal Regions. Eutrophication models: Simplified nutrient loading models for rivers and lakes.	10
Groundwater Quality: Basic differential equations with analytical solutions for 1-D case. Fate and transport in air, soil, surface and ground media.	04
Air quality modelling: Gaussian plume model – for point source. Gaussian dispersion co-efficient, Downwind ground-level concentration computation, maximum ground level concentration.	08
Total	**52**

TEXT BOOKS

- Schnoor J.L., (1997), "Environmental Modelling –Fate and Transport of Pollutants in Water, Air and Soil", John Wiley and Sons.
- Thomann R.V., & Mueller M. J., (1987), "Principles of Water Quality Modelling and Control", Harper & Row Publishers.
- Metcalf & Eddy Inc, (2003), "Wastewater Engineering, Treatment and Reuse"- 3rd Edition, Tata McGraw Hill Publishers Co. Ltd, New Delhi.

REFERENCES

- Freeze R.A. and Cherry J.A., (1979), "Groundwater", Prentice Hall, New Jersey
- Weber W.J., (1972), "Physico - Chemical Processes for Water Quality", John Wiley & Sons,
- Fischer H. B., List E.J., Koh R.C.Y., Imberger J., Brooks N.H., (1979), "Mixing in Inland and Coastal Waters", Academic Press Inc.

MANAGEMENT PRACTICES IN ENVIRONMENTAL ENGINEERING

EV 820 **L:T:P- 3:0:0** **CIE:50Marks**

Hours/week: 3(L) **SEE:100Marks**

Course Objective: This course enhances leadership qualities through communication and managerial skills in the student with a refined knowledge on proactive management issues, human resources management, analytical skills for effective project formulation and implementation. The course also invokes creative thinking on newer pollution prevention mechanisms through collaborative research

Course outcomes (Cos)
At the end of the course, the students will be able to:

CO1: Clearly distinguishes between reactive and proactive management, able to correlate between environment and economy and understands the need for organizational structure for effective environmental management
CO2: Develop ability to define functions and identifies types and levels of management, develops SWOT /SWOC for improved management style
CO3: Builds the base for efficient personnel management by acquiring skills like time management, interactive leadership style, human relationship
CO4: Able to appreciate the project formulation, applies CPM & PERT for good decision making. Capable of planning appropriately using carrying capacity concept
CO5: Imbibes excellent communicating skill, understands the role of non-profit organizations and media in environmental management.

COURSE CONTENT	**Hours**
Introduction: Proactive and Reactive environmental management. Environment and economy – excludability and rivalry. Continuous and continual improvement. Organizational structure for Environmental Management at central and state levels. Environmental audits.	09
Management Basics & Strategies: Definitions of management, Functions of management - classification, coordination, Types and levels of management, TOWS matrix, TQM and environmental protection, ISO 14000 and 18000 series of Standards.	09
Personnel management: Motivation–importance, need theory-Moslow, pre-requisites. Time and man management, factors of production and entrepreneurship. Employee-employer relationship, leadership styles and situational model, leadership qualities. Communication – elements and objectives, characteristics, barriers, (verbal &nonverbal), downward & upward, factors and soft skills. Safety management, Environmental due-diligence	08
Project formulation: Bar chart & milestone charts, programme evaluation & review technique (PERT) & time estimates, Critical path method (CPM) and scheduling, decision matrix – problems.	08
Cleaner technologies: Cleaner production and prevention of pollution in small businesses, CT and their role in environmental management: limitations. Incorporating	08

cleaner production in to EIA. Life cycle assessment in to process, zero emissions-the ultimate goal of cleaner production. CP in select red category industries – mining, breweries, pulp and paper mills.	
Environmental communication: Role of institutions, (NGOs, GOs, educational institutions), role of public, media.	06
Environmental Research: Need, areas of research, applied and advanced research, premier research organizations.	04
Total	52

TEXT BOOKS

- Lohani, B. N., (1984), "Environmental Quality Management" - South Asian Publishers, New Delhi.,
- Schermerhorn J.R., (2010), "Introduction to Management", Tenth Edition, International Student Version, John Wiley and Sons Inc., UK
- Richard Welford, (1999), "Corporate Environmental Management", Universities Press.

REFERENCES

- Suresh, K. and Dhameja, (2000), "Environmental Engineering and Management" ,S.K. Kataria and Sons
- Peurifoy, R. L., (1979), "Construction Planning Equipment and Methods", McGraw Hill.
- Banga, and Sharma, (2007), "Industrial Organization and Engineering Economics", Khanna Publishers.

NATURAL RESOURCES CONSERVATION AND MANAGEMENT (ELECTIVE III)

EV 831 **L:T:P- 3:0:0** **CIE:50 Marks**

Hours/week: 3(L) **SEE:100 Marks**

Course Objective: This unique course gives the student the feel and understanding of natural resources availability, their use and abuse, need for conservation. It equips the student with a thorough understanding of biodiversity, planning and legislation for effective resource management.

Course outcomes (Cos)
At the end of the course, the students will be able to:

CO1: Classify natural resources, identifies the threats and comprehends the flow of resources in nature.
CO2: Enhances thinking capability on issues such as resource allocation, use and pollution problems of forests, water, and abiotic components of natural resources.
CO3: Outlines the importance of food security, modern agricultural practices, use and impact of chemical fertilizers and pesticides. Able to estimate and identify food production and its problems related to storage, transport and allocation.
CO4: Capable of determining energy demand. Able to understand the energy footprint, crisis in energy production, impacts of fossil fuel burning. Develops knowledge on alternate energy sources for sustainable development.
CO5: Understands symbiotic and synergic relationships of different ecosystems. Appreciates the need for conserving biodiversity and identifies possible threats. Able to list and appreciate the ecological importance of major biodiversity hot-spots. Capable of applying the knowledge of environmental legislation for resource management.

COURSE CONTENT	**Hours**
Natural resources Classification, Resources Appraisal, Resource problem, Renewable resources flow, destruction versus conservation	04
Forest Resources Uses, Ecological and economic significance, types and management, forest resources of the world and India, deforestation and its impact and solution	04
Water Resources Hydrologic cycle, global and national water resources, demand and distribution, Classification of surface water bodies for designated best usage. Management of water resources, Environmental Impact of large dams, River water disputes, water pollution problems.	04
Mineral Resources Exploration, causes for depletion, environmental impacts and conservation measures.	04
Food Resources World food production and problems, food security, agri production, live-stock production, modern agri practices, use of pesticides and fertilizers – environmental impact, environmental limits of increasing food production, sustainable agriculture	04

Energy Resources Energy resources, world energy demand, Indian resources, renewable, alternate / non-conventional energy resources – solar, tidal, wind, geothermal, hydel, hydrogen, biomass, nuclear, wave (ocean)	04
Land Resources Land as a resource, soils – types and degradation- soil erosion and pollution, soil conservation	04
Biodiversity Resources Genetic and species diversity, Ecosystem diversity, types of ecosystems- structure and function, symbiotic and synergic relationship, importance of biodiversity, value of biodiversity, hot-spots of biodiversity, threats to biodiversity, conservation of biodiversity	07
Environmental Legislation for resource management Legal frame work, organizations and institutions, acts promulgated by India – Wild Life Act, Biodiversity Conservation Act, Environmental (Protection) Act, Forest Act	04
Total	39

TEXT BOOKS

- Anjaneyulu Y., (2004), "Introduction to Environmental Science", B.S. Publications, Hyderabad
- Misra S.P. and Pandey S.N., (2008), "Essential Environmental Studies", Ane Book Publishers, New Delhi.

REFERENCES

- Centre for science and environment (CSE)

CLIMATE CHANGE AND EMISSION TRADING (ELECTIVE III)

EV 832 **L: T:P- 3:0:0** **CIE:50 Marks**

Hours/week: 3(L) **SEE:100 Marks**

Course Objective: The course outlines higher level concepts of drivers and impacts of climate change, sectorial climate models, vulnerability and adaptability, and possible mitigative measures. It introduces Indian climate change scenario. The course also covers the importance of emission trading, trading mechanisms, regulatory framework and market potential.

Course outcomes (Cos)
At the end of the course, the students will be able to:

CO1: Comprehend the history of climate change, identify the major drivers of climate change, discuss the climate change models and their application in different sectors
CO2: Identify and explain the impacts of climate change on various sectors globally and understand the assessment of vulnerability
CO3: Assess impacts of climate change on various sectors in India and propose appropriate mitigation measures
CO4: Describe spatial dimensions, mechanisms and implementation of emission trading along with its pros and cons.
CO5: Aware of market feel and potential of emission trading along with monitoring and enforcement framework.

COURSE CONTENT	**Hours**
Introduction: Earth's climate, climate change, causes/drivers of climate change,	04
Climate models: Models for climate change, GCMs, RCMs, designing climate change experiments with climate models, climate change scenarios. Sector models – water resources, agriculture, forestry, energy.	05
Climate change impacts: Impacts of climate change on environment, human, agriculture, energy systems, coastal zone**.**	04
Vulnerability/adaptation: Need for vulnerability assessment; generic steps, approaches and tools of assessment; adaptation to climate change by various sectors. **Mitigation:** Mitigation measures for climate change	03
Climate change and India: impacts, sectoral and regional vulnerability in India, Evaluation of model simulation over India; National and international efforts/ policies to address climate change	08
Emission trading Introduction to emission trading, evolution of emission trading and design features Cost-effective permit markets, the role of transaction costs, the role of technical change, Consequences of emission trading	04
The spatial dimensions: difficulties in implementing an ambient permit system, possible alternatives, nature of evidence, borrowing, banking, and environmental target, Linking emissions and pollutant concentrations. Strategies for controlling seasonal or episodic peaks and allocation approaches	05
Market power: optimal design of permit allocation mechanisms and market stabilizing,	04

conceptual models, mechanisms for controlling market power, impacts on market structure and on international competitiveness, incentives for innovation in clean technologies	
Monitoring and enforcement: Domestic and international enforcement process, current enforcement practice, program effectiveness and economic costs	02
Total	39

TEXT BOOKS

- Shukla, P.R., Subodh K. Sharma, N. H. Ravindranath, Amit Garg, Sumana Bhattacharya. (2003), "Climate Change and India: Vulnerability Assessment and Adaptation" - Universities Press (India) Private Limited
- Konrad Soyez, and HartmutGrabl ,(2008), Basic Facts, Evaluation and Technological Options" - Springer Publications

REFERENCES

- UNFCCC Reports on Climate Change.
- Thomas H. Tietenberg ,(2006), "Emissions Trading: Principles and Practice", 2nd Edition, REF Press Book
- Noel D Nevers, (2000), " Air Pollution Control Engineering", McGraw Hill International Editions, Civil Engineering Series, McGraw Hill
- Wark K., Warner C.F., and Davis W.T., (1997), "Air Pollution – Its Origin and Control", Third Edition, Prentice Hall of India Publishers

INSTRUMENTATION AND AUTOMATION IN ENVIRONMENTAL ENGINEERING (ELECTIVE III)

EV 833 **L: T:P- 3:0:0** **CIE:50Marks**

Hours/week: 3(L) **SEE:100Marks**

Course Objective: The Course will expose the student to various facets of analytical instruments to be used in analyzing organic and inorganic present in water, wastewater and air samples and also to understand the automated water/ wastewater treatment processes (SCADA)

Course outcomes (Cos)

At the end of the course, the students will be able to:

CO1: Discuss the method of analysis of color and single component organics present in water and wastewater.
CO2: Explain the method of analysis of sodium and potassium present in soil and water samples.
CO3: Apply the knowledge of usage of mass spectrometer in the analysis of various parameters such as heavy metal ions, inorganic present in water and wastewater samples and also to explain the SCADA system to understand the automated water and wastewater treatment processes.
CO4: Explain the method of analysis of various end products of aerobic/ anaerobic digestion process.
CO5: Describe the determination of density of liquid/ gaseous samples and to know the measurement of pCO2 and pO2 present in different phases of medium.

COURSE CONTENT	**Hours**
Visible Ultraviolet spectrophotometers: Electromagnetic radiation, Beer Lambert law, absorption instruments, colorimeters, spectrophotometers, infrared spectroscopy theory, instrument and its types.	04
Flame photometers: Principle of flame photometers constructional details of flame photometers, accessories of flame photometers, interference in flame photometry and determinations	05
Fluorimeters & Phosphorimeters: Principle of fluorescence, measurement of fluorescence, spectro fluorescence, Measurement of Phosphorescence.	04
Mass spectrometer: Basic concept, types of mass spectrometer, components of mass spectrometer, resolution and applications	04
Automated bio-chemical analysis systems: Basic concepts, system details, system components, typical multiple analysis system, flow injection analysis. SCADA in water and wastewater system.	05
Chromatography: Gas chromatography –basic concepts, parts of gas chromatography. Method of peak areas, liquid chromatography – basic concepts, types if liquid chromatography, the liquid chromatograph.	05
Electrophoresis and densitometers: Basic Electrophoresis, Electrophoresis technique, paper Electrophoresis, Electrophoresis apparatus, spectrodensitometer, microprocessor-based densitometer, microelectrophoresis.	05
Gas analyser: Principle of pH measurement, pCO_2 and pO_2 measurement in Automatic exhaust gas analyser.	05
Online monitoring devices for liquid samples and ambient air and data dissemination.	02
Total	39

TEXT BOOK:

- Hand book of analytical Instruments by R. S. Khandpur, TMH publication 1st Ed 1989, New Delhi.

REFERENCE BOOKS:

- Instrumental methods of analysis by H. H Willard, L. L. Merritt & J. A. Dean, CBS Publications 7th Ed 1988.
- Principles of Instrumental analysis by S. J. Holler & T. A. Nilman Saunders college Publications 5th Ed 1998.

TECHNICAL SEMINAR ON CURRENT ENVIRONMENTAL ISSUES

EV840 **L:T:P- 0:0:4** **CIE: 50 Marks**

Hours/week: 4(P)

Course Objective:

The student gets an opportunity to search, understand and select an appropriate contemporary environmental issue. Improvises the skills of resource findings and utilization, comprehension, understanding and inferring. Able to prepare an abridged version of seminar report. Develops good communication and presentation skills.

Course Outcomes

At the end of the course the students will be able to:

CO1: critically review current environmental issues.
CO2: develop writing and presentation skills based on the literature reviewed.
CO3: develop creative thinking to provide futuristic perspectives

Course delivery
• Identify current environmental challenges for literature review • Collect recent publications from peer reviewed journals, technical reports and manuals. • Critically review the content and prepare the seminar report and presentation.

PROJECT WORK

EV850	**L:T:P- 0:0:16**	**CIE:70Marks**
Hours/week: 16(P)		**SEE:30Marks**

Course Objective:

The student will be able to apply the scientific and technical knowledge gained through various theory and laboratory courses. The project work also inculcates in the student creative thinking, planning, team work culture, time management. Develops leadership qualities and managerial skills.

Course Outcomes

At the end of the course the students will be able to:

CO1: experience practical exposure to wide variety of problems.
CO2: develop skill in terms of design, analytics and laboratory scale experiments.
CO3: develop writing skills for report preparation, paper publication and presentation

Course delivery
• Identify current environmental issues for project work • Critical literature reviews to identify research gaps. • Collect recent publications from non-predatory journals, technical reports and manuals. • Design of experiments/ laboratory scale experiments/ management / software utility for simulation and design/ Mathematical modeling of environmental system / data analysis and interpretation. • Prepare the project report and presentation. • Prepare papers for presentation in seminars / conferences /symposium/workshops and technical paper publications in peer reviewed journals.